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## **Science & Technology**

***Central Eurasia:  
Electronics & Electrical Engineering***

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# Science & Technology

## Central Eurasia: Electronics & Electrical Engineering

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### **Vircators (A Survey)**

927K0304 Moscow *RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 37 No 3, Mar 92*  
(manuscript received 4 Feb 91) pp 385-396

[Article by A. A. Rukhadze, S. D. Stolbetsov, and V. P. Tarakanov; UDC 621.385.6]

[Abstract] When the current of an electron beam injected into a drift chamber is sufficiently high, a virtual cathode is formed in the system. Electrons are reflected from the virtual cathode toward the injector. Under certain conditions the reflected electrons reach the cathode, and the process is repeated. Some of the electrons oscillate in a potential well between the cathode and the virtual cathode. The virtual cathode itself oscillates with a frequency near the plasma frequency of the beam electrons. The current, which is modulated near the virtual cathode, may interact with the intrinsic modes of the resonator, in turn leading to powerful UHF radiation. Devices based on the use of a virtual cathode are called vircators. This article examines the problem of the generation of powerful UHF radiation in systems with a virtual cathode. There are two types of vircators, triode and diode vircators. If the electrons oscillating between the cathode and the virtual cathode play a significant role, then the device is called a reflecting diode. If measures are taken to eliminate these oscillating electrons, the device is called a reditron. Vircators may be a source of UHF radiation in the 1-10 GHz range with a power of up to tens of gigawatts with pulse lengths reaching hundreds of nanoseconds. These resonant systems are simple to construct and are rather insensitive to beam quality. Attempts to improve the parameters of vircator generators have yielded only minor improvements. Programs exist to model vircators, and they yield results in good agreement with experimental results. These programs could be used to determine optimal parameters and refine the mechanisms of radiation in vircators. Table 1; references 63: 28 Russian, 35 Western.

### **Synthesis of a Multipole Circuit To Model the Characteristics of a Slowing System in the Form of a Chain of Linked Resonators**

927K0304B Moscow *RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 37 No 3, Mar 92*  
(manuscript received 1 Apr 91) pp 397-404

[Article by A. V. Malykhin and A. S. Solov'yev; UDC 621.385.632.14]

[Abstract] A method is proposed to synthesize a multipole circuit using known electrodynamic characteristics of a slowing system in the form of a chain of linked resonators. This makes it possible to model the distribution of a high-frequency field at individual points of the interaction space. Different approximations of a model of the cell of a slowing system in the form of a chain of linked resonators are presented. The chain has a sliding symmetry plane in the form of a six-pole and eight-pole

circuit. An example is presented of the synthesis of the characteristics of a specific slowing system. This method has a sufficiently high level of accuracy and requires little computer time. This method makes it possible to model the interaction processes of spatially developed electron beams with the high-frequency fields of O-type devices. Figures 5; references 7: 6 Russian, 1 Western.

### **Electric Impedance of a Composite UHF Acoustic Resonator**

927K0304C Moscow *RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 37 No 3, Mar 92*  
(manuscript received 16 Sep 91) pp 404-411

[Article by V. S. Veretin, A. G. Kozorezov, B. N. Krutov, and G. D. Mansfeld; UDC 621.37/39:534]

[Abstract] Resonators which use three-dimensional acoustic waves may be used to select and stabilize frequencies in the UHF range. At 3-10 GHz composite three-dimensional acoustic wave resonators based on layered structures may obtain extremely high quality factors which are unattainable with devices which use surface acoustic waves. A drawback of the composite resonator is that it is a multimode device, but this can be useful, for example, when used in frequency synthesizers. A general expression is obtained for the impedance of a resonator structure in the form of a semiconductor film with a dielectric layer. The piezoelectric and potential-deformation mechanisms of the electromechanical circuit are examined. The formulas which are obtained can be used to evaluate the frequency characteristics of the impedance of composite structures for arbitrary semiconductor and dielectric materials in a wide range of temperatures and frequencies. Figures 5; references 8: 6 Russian, 2 Western.

### **Diffraction of Electromagnetic Waves on the Edges of Impedance Bodies**

927K0304D Moscow *RADIOTEKHNIKA I  
ELEKTRONIKA in Russian Vol 37 No 3, Mar 92*  
(manuscript received 3 Jun 91) pp 412-418

[Article by Ye. V. Zakharov and I. G. Yarmakhov; UDC 539.574.6]

[Abstract] Integrals are obtained which describe the diffraction of electromagnetic waves in angular incidence on an impedance wedge with a rounded edge. An auxiliary problem is examined to find the asymptotic solution which holds true far from the edge of the wedge, and the nondecreasing part of the solution is isolated. The results can be used to analyze the effect of edges on apertures and screens, as well as to study the effect of absorbing coatings on bodies like a wedge with an arbitrary aperture angle. Numerical experiments found that the regular character of the surface field is established at a distance of about  $15\lambda$  from the edge of the wedge. This is in good agreement with other results for coatings with and without losses. The surface impedance

was constant. Results for a thinner absorbing coating (vertical incidence) showed that the amplitude of the surface field oscillates due to the interaction of incident and reflected fields of a surface wave stimulated by the edge. The presence of an absorbing coating on an ideally conducting wedge leads to a significant decrease in the amplitude of the diffraction field in the opposite direction. Figures 5; references 9: 6 Russian, 3 Western.

### **Spectral Analysis of the Range Properties of Flat Sectorial Radiators**

927K0304E Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 37 No 3, Mar 92* (manuscript received 8 Oct 90) pp 423-431

[Article by Ye. A. Konyashenko and V. F. Kim; UDC 621.396.67.3]

[Abstract] This article shows the effectiveness of expanding spectral representations for current distributions with cylindrical symmetry. The range properties of a flat sectorial radiator are analyzed. It is shown that by selecting the appropriate geometric dimensions in a class of sectorial radiators one can obtain better range properties than in a class of right-angle apertures. For sectorial radiators with angles greater than or approximately equal to  $30^\circ$  there is little change in the input impedance in the region of radiator lengths corresponding to the second resonance. This change is characteristic of vibrator type radiators with a right-angle aperture. Consequently, sectorial radiators have better range properties. This article uses the concept of K-space to examine the problem of the stimulation of flat sectorial radiators. An analysis is given of the frequency-invariant properties of the energy functionals obtained in the process of solving the limit problem. The impedance characteristics are calculated in a wide range of frequencies. Figures 5; references 5: 4 Russian, 1 Western.

### **Asymptotically Invariant Detection of a Weak Fading Signal on a Background of Noise of Unknown Intensity**

927K0304F Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 37 No 3, Mar 92* (manuscript received 3 Aug 90) pp 443-449

[Article by G. M. Bashin; UDC 621.391.01]

[Abstract] This article examines the problem of detecting a weak fading signal on a background of independent noise with unknown stability characteristics in the presence of learning samples. Previous results are outlined. Asymptotically invariant rules are obtained for detecting a random signal in multichannel systems with a linear envelope detector for prolonged incoherent collection. These rules were generalized to a multi-alternative case and are extended here to the case of detecting a weak signal received in a channel with scattering. The simple asymptotically optimal solving rules (including multi-alternative rules) obtained here for detecting a weak

fading signal on a background of Gaussian noise of unknown intensity can be used to create automatic detectors with a false-alarm probability independent of noise intensity. These detectors are stable for noise with a non-Gaussian distribution, and losses in intensity, compared to the case of known noise intensity, depend on the number of learning samples and rapidly decrease as the latter increases. References 16 (Russian).

### **Adaptive Isolation of Signals on a Background of Intense Noise in Multichannel Systems**

927K0304G Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 37 No 3, Mar 92* (manuscript received 4 Dec 90) pp 449-458

[Article by O. P. Cheremisin; UDC 621.372.54.01]

[Abstract] In the framework of an adaptive Bayes approach an algorithm is synthesized to isolate a useful signal on a background of intense noise of arbitrary form in a multichannel receiving system. The effectiveness of the algorithm which is obtained is studied for the case of detection of a quasi-determined signal, and it is shown that the algorithm is invariant to the level of intense noise signals and fixes the frequency of false alarms. The quality of detection depends only on the degree of linear dependence of the useful signal and noise in the multichannel receiving system. In the multichannel receiving systems examined here, processing can be separated into spatial and temporal processing. An example is a receiving system with an antenna array which digitizes signals at the output of elements or modules. The digitized signals may be subjected to either a Fourier transform or to convolution with a set of reference signals, forming a sequence of readings of observed signals at the output of the system. Figure 1; references 7: 5 Russian, 2 Western.

### **Complex Dynamics of Very Simple Electronic Neural-Like Systems**

927K0304H Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 37 No 3, Mar 92* (manuscript received 5 July 91) pp 479-487

[Article by A. S. Dmitriyev and D. A. Kuminov; UDC 534.01;621.373;621.391]

[Abstract] The model of a neural-like system, despite its simplicity, demonstrates a wide range of dynamic phenomena existing in natural neural systems. The model developed here is described by a system of common second-order differential equations which has complex dynamics for a small number of elements. When appropriate damping parameters are chosen it changes into a Hopfield net model, which makes it possible to compare the properties of these two classes of systems. This model is based on the Hopfield model, and the Hopfield model is described in detail. In the proposed model, as in the Hopfield model, there are many equilibrium positions which may be used to record samples. However, there is

another opportunity, the ability to record samples using both static and dynamic attractors, such as limit cycles, tori, and chaotic attractors. An important feature is that the network is organized on the basis of oscillation elements. This makes it possible to use many important results on the dynamics of oscillators and systems of oscillators to analyze and interpret modes. Figures 5; references 13: 7 Russian, 6 Western.

#### **Millimeter Range Noise Source Based on an Electronic Amplifier**

927K0304I Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 37 No 3, Mar 92 (manuscript received 1 Jul 91) pp 521-526

[Article by V. L. Vaks, A. V. Smorgonskiy, and A. O. Shuleshov; UDC 621.385.632]

[Abstract] This article describes the results of an experiment to synthesize a high-frequency noise signal using a traveling wave tube. It is shown that the modulation of an accelerating voltage by a low-frequency noise signal leads to the appearance of a noise signal at the output of the amplifier in the working range of frequencies when a number of conditions are met. A noise signal can be switched to the UHF range with simultaneous expansion of the noise band. It is shown that the mechanism of spectral enrichment based solely on nonlinearities of the electron beam requires that very specific conditions be met. However, the experiment described in this article shows that if low-frequency noise is used as a modulating signal, a high-frequency wideband noise signal can be obtained in the typical operating modes of standard lamps. Figures 5; references 2 (Russian).

#### **Meter of Electrical Parameters of High-Voltage Pulses Under Break-Down Conditions of Dielectric Materials**

927K0301A *PRIBORY I TEKNIKA EKSPERIMENTA* in Russian No 2, Feb 92 pp 143-146

[Article by A. A. Proskurin, V. I. Krivoviyaz, A. G. Yegorov, Institute of physics, strength and material science, Siberian Branch of Russian Academy of Sciences, Tomsk; UDC 621.3.049.77:621.383]

[Abstract] An instrument was developed for measuring the fundamental electrical parameters under conditions of high-voltage pulse break-down of dielectric materials. The maximum voltage amplitude and pulse duration are measured, before the break-down, and the digital oscillogram of the current and voltage pulses are obtained during the arcing stage with consequent computation of power, resistance and energy. Because of automatic compensation of the inductive voltage component it is possible to compute the energy dissipated in the discharge channel. Outputs are provided for a computer processing of the data. The range of the input voltages is  $\pm 5$  Volts, pulses with duration from 50 nsec to 1,000 nsec can be measured and the sampling rate during the

arcing stage is 10 MHz. The parameter's measurement error is not greater than 5 percent. Functioning of the device is comprehensively described and a block diagram and electrical circuit of the instrument are provided. Figures 3, references 3: Russian.

#### **Powerful Linear Modulator**

927K0301B *PRIBORY I TEKNIKA EKSPERIMENTA* in Russian No 2, Feb 92 pp 147-149

[Article by S. P. Aristarkhov, A. V. Muratov, Yu. V. Solovyev, V. E. Ermel, Scientific Research Institute for Electrophysical Equipment, St. Petersburg; UDC 621.373.44]

[Abstract] A linear modulator is described which is designed for supplying pulses to a powerful klystron of a linear accelerator of electrons, used in the beam technology. When the pulse voltage is 55 kV and the pulse repetition rate is 600 Hz, the output power of the modulator is in the 60-65 kW range. The modulator is power supplied from a 3 x 380 V line through a transformer-rectifier unit with two parallel connected capacitors at the output, whose total capacitance is 24  $\mu$ F. The inductive-diode circuit of the charge forming line is made of 28 avalanche diodes and a non-linear choke. The modulator's dimensions are 1,900 x 800 x 2,000mm<sup>3</sup>. Figures 2, references 2: Russian

#### **Calorimeter for Energy Measurements of a Powerful Electromagnetic Pulse**

927K0301C *PRIBORY I TEKNIKA EKSPERIMENTA* in Russian No 2, Feb 92 pp 153-154

[Article by N. I. Zaytsev, Ye. V. Ilyakov, Yu. K. Kovneristyy, G. S. Korablev, I. S. Kulagin, I. Yu. Lazareva, V. I. Tsalolikhin, V. V. Shulgin, Institute of Applied Sciences, Russian Academy of Sciences, Nizhniy Novgorod; UDC 621.317.382.029.64]

[Abstract] A calorimeter is described for measuring pulse energy up to 100 MW in the centimeter wave range. The calorimeter is made of a copper tube with absorbing material, a conical reflector and a copper-constantan thermal battery, whose 16 sections are uniformly distributed along the tube surface. The calorimeter was tested for electrical strength by connecting a relativistic microwave generator with known characteristics to the output waveguide and also by positioning the calorimeter in a wave beam with a Gaussian field distribution. In the first test the microwave pulse duration was 300 nsec with 25 MW power, and in the second test the power was 200 MW and the pulse duration 50 nsec. The energy measurements error was 10 percent. Figures 2, references 4: 3 Russian, 1 Western.

**High-Voltage Pulses Forming Circuit With Inductive Storage of Energy**927K0301D *PRIBORY I TEKHNKA**EKSPERIMENTA in Russian No 2, Feb 92 pp 157-159*

[Article by I. M. Gavrilov, Istra Branch of All-Union Electrotechnical Institute; UDC 621.373]

[Abstract] A high-voltage pulse forming circuit with inductive energy storage is described which is used for generating powerful periodic millisecond pulses. The commutating device is constructed with a multistage current switching circuit. The commutator of the first stage remains in a conducting state for a relatively long time allowing the inductive energy storage to be charged. The second stage commutator remains under current a considerably shorter time and functions as a fast acting switch. A capacitor is connected in series with the commutator, providing the necessary conditions for passing the current in the circuit during the time needed for the first stage commutator recovery. The pulse forming circuit contains an inductive storage, a first stage commutator which is made of two high-voltage modular thyristor units, a second stage commutator with three triodes, a capacitor, an inductance coil, three thyristor switches and the power supplies. The model of the device constructed with the described circuit was capable of switching 800 A current into the load with the voltage amplitude of 40 kV, operating frequency 1-50 Hz, pulse duration of 0.1-2 msec, and pulse front duration of 10  $\mu$ sec. Figures 2, references 5 Russian.

**Powerful Magnetic Pulse Generator**927K0301E *PRIBORY I TEKHNKA**EKSPERIMENTA in Russian No 2, Feb 92 pp 160-162*

[Article by Yu. P. Vakhrushin, P. V. Tkherev, V. E. Ermel, Yakovlev, (D. V. Yefremov Scientific Research Institute for Electro-Physical Instruments, St. Petersburg); UDC 621.386.64]

[Abstract] A magnetic pulse generator was developed for application with a linear induction accelerator with the objective to increase the pulse power and the compression coefficient. The generator contains a modular thyatron, and three current compression stages. For pulsed voltage of 26 kV the maximum output power of the generator is 1.4 GW. The generator's load resistance is 0.5 Ohm, the pulse duration is 160 nsec (at the 0.5 amplitude level). The current compression coefficient is 35 when the amplitude of the output current pulse is 53 kA. Theoretical computations were also carried out and are in good agreement with the experimental results of measurements made with the prototype. Figures 2, references 3: Russian.

**Performance of the PBU-63-20 Discharger Under High-Current Operation Conditions**927K0301F *PRIBORY I TEKHNKA**EKSPERIMENTA in Russian No 2, Feb 92 pp 163-166*

[Article by V. S. Bogdanov, B. A. Borisov, V. I. Goloshchapov, V. A. Lavrinovich, All-Union Scientific Research Institute for Electrotechnical Industry, Minusinsk; UDC 621.387.35]

[Abstract] Performance of a standard discharger PBU-63-20 was studied to determine its life-time. Two modes of operation were examined: commutation in a circuit with a non-periodic current whose amplitude was between 80 and 100 kA, 2 msec pulse-width and a 100 Coulomb charge per pulse, and in a circuit with an attenuating sinusoidal current with 200 kA amplitude of the initial half-wave, current oscillation cycle of 600  $\mu$ sec carrying a 75 Coulomb charge. For generation of non-periodic current pulses a crowbar discharger was used. The dischargers were periodically exposed to high-voltage tests and the break-down voltages were recorded. In all cases the voltage of the break-down along the external surface of the dischargers was smaller than the voltage of the break-down of the internal insulation. The tests demonstrated that for the dischargers of the tested model, the most damaging mode of operation was in the circuit with the attenuating sinusoidal current. It was shown that the RBU-63-20 type discharger is capable of passing undamaged 2,000 times the electric charge of up to 100 Coulomb per discharge with current amplitude of 150 kA. In the non-periodic operating mode, under test conditions, the discharger anode suffered greater damage than the cathode. Figure 3, references: 5 Russian.

**Frequency Pseudo-Spark Discharger With a Nanosecond Activation Stability for Switching High-Current Short Pulses**927K0301G *PRIBORY I TEKHNKA**EKSPERIMENTA in Russian No 2, Feb 92 pp 167-170*

[Article by V. S. Bogdanov, K. A. Klimenko, A. V. Kolesnikov, Yu. D. Korolev, V. A. Lavrinovich, V. G. Rabotkin, I. A. Shemyakin, Institute of High-Power Electronics, Siberian Branch of Russian Academy of Sciences, Tomsk; UDC 621.316.933]

[Abstract] Low pressure dischargers with a cold cathode and hollow electrodes, which are called pseudo-spark discharger are used for commutation of high current, high voltage micropulses. A metal-ceramic discharger is described in this paper which can provide a nanosecond stability of the activating pulse and a parallel operating mode of several devices to a common load with an operating voltage of up to 20 kV for commutation of high current - (10 kA), short - (< one  $\mu$ sec) pulses. Several dischargers were tested for their serviceability without deterioration of functioning under the following conditions: pulse repetition rate - 50 s<sup>-1</sup>, anode voltage - 15 kV, capacitance - 47 nF, wave resistance of the discharge circuit - 1.7 Ohm, load resistance - 1.4 Ohm,

gas pressure -  $3 \times 10^{-2}$  Torr, discharge voltage - 7 kV. For different samples the serviceable life-time was within  $(0.5 - 1)10^6$  activating pulses. Figures 2, references 7: 4 Russian, 3 Western.

### **Optoelectronic Device for Voltage Control With Power Supplied Via Light-Guide**

927K0301H PRIBORY I TEKHNIKA

EKSPERIMENTA in Russian No 2, Feb 92 pp 174-176

[Article by N. G. Stervoedov, Kharkov University; UDC 681.325.3:621.345.132]

[Abstract] A simple device with optical decoupling and pulsed power supply is described. The device is designed for experiments and technological control of instruments under conditions of intensive electromagnetic interference generated by electrophysical equipment. The developed circuit contains four functional elements: an illumination and synchronization generator, a secondary optoelectronic transducer of pulsed power supply, a measurements transducer with optical output and an optical detector - transducer. The illumination and synchronization generator produces 30  $\mu$ sec wide light pulses in the 23 kHz range, and the synchronization circuit puts out pulses which periodically cut off the illumination pulses which open the switch controlling the light diode. The engineering characteristics of the device are: the range of the measured input voltages 0.01-1.0 V; measurement accuracy 1.0 percent; maximum frequency of measurements 50 Hz; the GSZh OBS-1-4-4,000 type light-guides, 4 m long were used; the high voltage was  $1-10^6$  V. The circuits were tested and operated with high voltage accelerators of charge particles. Figures 1, references 4 Russian.

### **Short Current Pulse Shaping Circuit for Controlling the Electron-Beam Gun**

927K0301I PRIBORY I TEKHNIKA EKSPERIMENTA  
in Russian No 2, Feb 92 pp 177-178

[Article by A. Ye. Zarvin, V. N. Kolevatov, V. V. Kolyada, V. Zh. Madirbayev, Novosibirsk University; UDC 621.396.669]

[Abstract] A device for controlling the current of a beam produced by a triode electron-beam gun is described. The electronic-optical systems are used for measuring the density field, population of the internal degree of freedom, and distribution function of molecules by

speed in rarefied gas flow. With such measurements a focused continuous electron beam 10-30 keV strong is applied to the examined gas object and the produced radiation is analyzed. In order to reduce the effects of secondary processes which accompany interaction of the diagnostic electron beam with the emitted gas and to expand application of the electron beam diagnostic to a higher density region, a pulsed modulation system of the electron beam was developed and tested which makes it possible to form 0.6-10  $\mu$ sec wide electron pulses with an energy of 5-30 keV and pulse repetition rate from 1 Hz to 30 kHz. Laboratory tests of the control device demonstrated its high reliability. At the present time it is used in an electron-beam diagnostic system with a gas-dynamics stand. Figures 2, references 3 Russian.

### **Magnetically Isolated Diode With $B_r$ -Field Used as a Generator of Powerful Ion Beam With Microsecond Duration**

927K0301J PRIBORY I TEKHNIKA

EKSPERIMENTA in Russian No 2, Feb 92 pp 179-182

[Article by S. N. Volkov, Ya. Ye. Krasik, N. M. Polkovnikova, V. A. Sinebryukhov, V. B. Karpov, P. S. Ananin, Scientific Research Institute for Nuclear Physics, Tomsk Polytechnic Institute; UDC 537.533.6]

[Abstract] The results of a study dealing with generation of a powerful microsecond long ion beam in a magnetically isolated plain diode with an external radially distributed isolating field are described. An ion beam with a circular cross section consisting basically of  $H^+$  and  $C^+$  ions was examined. The energy range occupied by most of the generated ions was 300-500 keV. The total beam energy removed from the diode was 10 kJ with 60 percent efficiency. The study was conducted using a microsecond generator, operating in a positive high-voltage pulse generation mode with an amplitude below 600 kV. The dependance was examined of the diode characteristic and the generated powerful ion beam on the induction of the isolating magnetic field and the anode-cathode gap for fixed charge voltages of 40 and 50 kV. These voltages correspond to the amplitudes of the output voltages of 480 and 600 kV. The isolating magnetic field induction varied from 0 to 14 kHZ, and the inter-electrode gap varied from 13 to 26 mm. The obtained curves showing changes in the diode impedance as a function of time indicate that the length of the magnetic isolation phase increases with increased amplitude of the isolating magnetic field. Figures 4, references 5: 4 Russian, 1 Western.

**Digital Phase Meter for Weak Low-Frequency Signals**

927K0291A Moscow PRIBORY I TEKNIKA  
EKSPERIMENTA in Russian No 1, Jan-Feb 92  
(manuscript received 7 Mar 91) pp 115-121

[Article by V. V. Ruban and A. D. Ivliyev, Sverdlovsk Mining Institute; UDC 621.376.43]

[Abstract] This device is intended to measure the phase delay of a sinusoidal signal (the phase shift of a harmonic signal or the first harmonic of a complex signal) in the 2-100 Hz frequency band with amplitudes of  $4\text{ }\mu\text{V}$ -4 mV. The signal is processed by a DVK-3 computer in real time using a quasi-optimal algorithm. A feature of the instrument is the absence of a reference voltage input channel in the computer (readings of a harmonic signal of reference voltage are stored in memory). The RMS error of the equipment is  $0.3^\circ$ . The output voltage of the signal source should be  $\leq 30\text{ k}\Omega$ . A reference voltage with an amplitude of 2.5 V is needed and may be pulsed or sinusoidal. The processing algorithm is described, and the three-step measurement process is outlined. First, the amplification coefficient is established; second, the period of the reference voltage is evaluated; and third, the phase shift is measured over several cycles. A schematic of the device is provided. Figures 3; references 8 (Russian).

**Wideband Amplifier With Pulsed Power Supply**

927K0291B Moscow PRIBORY I TEKNIKA  
EKSPERIMENTA in Russian No 1, Jan-Feb 92  
(manuscript received 5 Apr 91) pp 122-123

[Article by A. A. Titov, S. V. Melikhov and L. P. Donskikh, Tomsk Institute of Automated Control Systems and Radio Electronics; UDC 621.375.026]

[Abstract] It has been found that it is possible to substantially increase the efficiency of wideband amplifiers by using a pulsed voltage source. This article describes the schematic of an amplifier with a 30 dB coefficient of amplification which operates in the 3-500 mHz band. It has an output power of 5.5 W and the depth of manual regulation of amplification is 15 dB. The rise and fall time of the radio pulse is no greater than 30  $\mu\text{s}$  when the amplifier is forming radio pulses. Several design decisions are explained. The nonuniformity of the amplitude-frequency characteristic is  $\pm 0.5\text{ dB}$ , the resistance of the generator and load is 50  $\Omega$ , the required amplitude of the synchronization pulse is 1 V, and the power required to amplify continuous periodic oscillations is 42 W. Figures 1; references 3 (Russian).

**Device for Nanosecond Triggering of Megavolt Peaking Dischargers**

927K0291C Moscow PRIBORY I TEKNIKA  
EKSPERIMENTA in Russian No 1, Jan-Feb 92  
(manuscript received 7 Mar 91) pp 124-127

[Article by S. B. Yevlampiyev, G. S. Korshunov, and V. V. Shcherbakov, Scientific Research Institute of High Voltages at Tomsk Polytechnical Institute; UDC 621.373.431]

[Abstract] This article describes a device to trigger peaking trigatron dischargers in the megavolt range. The device forms pulses with an amplitude up to 300 kV in the control electrode with a front of  $<10\text{ ns}$  and a half-decay length of 70 ns. The minimum processing time of the device is  $150 \pm 10\text{ ns}$  when a pulse with a rise time of 0.3-0.5  $\mu\text{s}$  (to the amplitude value) is sent to the discharger. An ignition pulse generator at high potential is used to trigger the trigatron. The components and operation of the device are described and the specifications for use with other equipment are provided. Figures 2; references 6 (Russian).

**Use of Schottky Diodes To Multiply and Mix Frequencies in the Submillimeter Spectral Region (to 4 THz)**

927K0291D Moscow PRIBORY I TEKNIKA  
EKSPERIMENTA in Russian No 1, Jan-Feb 92  
(manuscript received 1 Mar 91) pp 128-130

[Article by V. F. Zakharyash, V. M. Klementyev, V. A. Timchenko, V. G. Bozhkov, and O. Yu. Malakhovskiy, Institute of Laser Physics, Siberian Division, USSR Academy of Sciences, Novosibirsk; UDC 621.391.822]

[Abstract] It is shown that as the area of a Schottky barrier diode decreases (with unchanged semiconductor parameters) speed increases and is determined only by resistance and the capacitance of the contact. At a diameter of  $<1\text{ }\mu\text{m}$  the frequency range of the device reaches 4.3 THz. The construction of the mixing and multiplying head is described. Harmonics with number  $N=37$  are obtained from a millimeter-range generator at a frequency of about 1.63 THz, and with  $N=27$  at about 2.45 THz. A waveguide model of the head was developed and its construction is described. A table presents the results of testing the Schottky barrier diode. The efficiency of generating higher-order harmonics is directly linked with the ability to decrease the diameter of the diode area. It also plays a key role in increasing speed. In some tests it was found that the Schottky barrier diode performed on the same level as a metal-oxide-metal diode, but exhibited better reliability. It is concluded that Schottky barrier diodes are promising for nonlinear elements in the submillimeter range. Figures 2; table 1; references 5: 3 Russian, 2 Western.

**Measurement of Energy-Bearing High-Current Pulse Electron Beams**

927K0291E Moscow PRIBORY I TEKNIKA  
EKSPERIMENTA in Russian No 1, Jan-Feb 92  
(manuscript received 17 Dec 90) pp 139-142

[Article by Yu. Ye. Kolyda, V. A. Skubko, B. F. Yermolenko, G. A. Senderovich, S. B. Fioletov, A. V. Filkin, and A. V. Garyazha; UDC 621.384.6]

[Abstract] Determining the energy content of high-current pulse electron beams is difficult because calorimetric or volt-ampere characteristic methods do not

always yield sufficiently accurate results. This article describes a method of determining the energy content of a pulse high-current electron beam by measuring the total absorbed dose of hard X-rays per pulse as the dose interacts with a solid state target. A mass-produced dosimeter is used (DRG3-04). The method was tested and the parameters of the experiment are provided. A good agreement of results was obtained, confirming the device's reliability. Figure 1; references 10 (Russian).

### Digital Fourier Spectrometer

927K0291F Moscow PRIBORY I TEKHNIKA  
EKSPERIMENTA in Russian No 1, Jan-Feb 92  
(manuscript received 25 Apr 91) pp 148-151

[Article by I. Yu. Borisenko, V. M. Zakosarenko, Ye. V. Illichev, and A. M. Orlov, Institute of Problems in Technology, Microelectronics, and Hyperpure Materials, USSR Academy of Sciences, Chernogolovka; UDC 621.3.011]

[Abstract] This article describes a Fourier spectrometer constructed on the basis of an IBM PC/AT computer attached to a CAMAC crate. The device also includes a strobe integrator and the following CAMAC units: a relay multiplexor 753-1, a real time clock 732A, a 13/20 analog-to-digital converter, a crate controller, and an instrument interface. Schematics are provided and the operation of the unit is outlined. An example is presented showing how the device is used to study the noise characteristics of a magnetic field in superconducting screens made of  $\text{YBa}_2\text{Cu}_3\text{O}_x$  ceramic at the boiling point of liquid nitrogen (77 K). The sensitive element is a high-temperature one-contact high-frequency squid

made of  $\text{YBa}_2\text{Cu}_3\text{O}_x$  ceramic with a sensor operating temperature of 77 K. A spectrum for the squid is presented and analyzed. Flicker noise detected in the spectrum is noted but not discussed. Figures 4; references 5 (Russian).

### Continuous Stabilized CO Laser Tunable to Wavelengths in the 5.3-6.3 $\mu\text{m}$ Band

927K0291G Moscow PRIBORY I TEKHNIKA  
EKSPERIMENTA in Russian No 1, Jan-Feb 92  
(manuscript received 4 Jan 91) pp 158-160

[Article by D. G. Letenko, V. N. Savratelyev, A. B. Fedortsov, and Yu. V. Churkin, Northwest Correspondence Polytechnical Institute, Leningrad; UDC 621.373.8]

[Abstract] When conducting experiments in the optical generation of nonequilibrium charge carriers in narrow-zone semiconductor materials, it is extremely useful to have a tunable source of coherent infrared radiation. This work describes a stabilized continuous CO laser which can be tuned in the 5.3-6.3  $\mu\text{m}$  range. This laser was developed on the basis of the mass-produced ILGN-706 CO laser. The schematic of the modified laser is presented. A new feature is the tuning system, which stabilizes the laser. The output mirror was replaced with an echelette. Other modifications are described. The radiation spectrum of the laser is presented. Up to 540 lines can be generated. The maximum output power in various lines was obtained at discharge currents of 10-18 mA and reached 600 mW. The relative power instability is  $\leq 2$  percent in one hour of operation. Figures 2; references 2: 1 Russian, 1 Western.

**Intelligent Network: Evolution of Communication Networks and Telephone and Telegraph Services***927K0278A Moscow ELEKTROSVYAZ in Russian  
No 1, Jan 92 (manuscript received 20 Sep 91) pp 2-7*

[Article by L. Ye. Varakin; UDC 621.395.383/384:339.94]

[Abstract] The burgeoning development of communication facilities and computer technology has given rise to a new concept in industrially developed nations: the Intelligent Network. It is anticipated that this concept will have become a reality by the year 2000. The Intelligent Network will be significantly different from previous systems in the flexibility of allocating services to the general user. The resulting increased demand will serve the interests of all parties: users, service vendors, and hardware vendors. A crucial problem in developing the Intelligent Network concept is coordination with the concept of Universal Personal Telecommunications (UPT), in which each subscriber will have a unique personal telephone number that can be used anywhere in the world. There are four major phases in the evolution of communication networks and telephone and telegraph services: development of universal telephone service, digitizing telephone lines, integration of services, and the Intelligent Network. The CIS is making considerable investments in each of these phases, and plans call for developing the scientific and engineering base for constructing the Intelligent Network (1991-1995), setting up regional Intelligent Digital Networks (1991-2000), and creating a State-Wide Intelligent Network (2000-2005). Figures 4, table 1, references 26: 13 Russian, 13 Western.

**Intelligent Network: Concept and Architecture***927K0278B Moscow ELEKTROSVYAZ in Russian  
No 1, Jan 92 (manuscript received 20 Sep 91) pp 7-10*

[Article by L. Ye. Varakin, A. Ye. Kucheryavyy, N. A. Sokolov and Yu. I. Filyushin; UDC 621.395:383/384:339.94]

[Abstract] The basic principles of the Intelligent Network have been worked out by the 11th and 18th study groups of the CCITT, which have suggested the following definition of the concept: the Intelligent Network is a network for setting up and allocating communication services typified by: extensive use of a variety of information processing methods; efficient utilization of network resources; modularity of network functions; simultaneity of creating and allocating services by means of universal (repeatedly used) network functions; flexible distribution of network functions with respect to physical elements of the network; capability of shifting network functions from one physical element of the network to another; standardized interaction between network functions via interfaces that are independent of the type of service; capability of user control of certain specific service attributes; standardized control of service logic.

Two essential features distinguish the Intelligent Network from other information networks: the user has the capability of managing services offered by the network, tailoring and ordering new services at the specific time that they are required; a database distributed through the network provides user access to required services regardless of their geographic location at a given time. The model of the Intelligent Network proposed by the CCITT consists of four planes, which are (from top to bottom): Intelligent Network services plane, general functional plane, distributed functional plane, and physical plane. Two undecided issues of the architecture are whether intelligence should be accommodated by digital telephone exchanges, or separated into a distinct entity, and whether intelligence should be centralized or distributed. There is as yet no agreement about the list of services that should be offered by the Intelligent Network. Figures 5, references 15: 1 Russian, 14 Western.

**Intelligent Network: Concept and Architecture***927K0278C Moscow ELEKTROSVYAZ in Russian  
No 1, Jan 92 (manuscript received 20 Sep 91) pp 10-11*

[Article by L. Ye. Varakin, A. Ye. Kucheryavyy, N. A. Sokolov and Yu. I. Filyushin; UDC 621.395:383/384:339.94]

[Abstract] Databases of three classes are needed in the Intelligent Network (not counting the specialized databases required for operation of switchgear): 1. recording database that connects the user terminal to the network, determines ID and passwords, credit parameters, allowed access to services, VPN capabilities and the like; 2. billing database that automatically issues statements for services and locks out subscribers who do not meet credit requirements; 3. service database that provides information in accordance with the orders of subscribers for services. The first two classes are currently realized in telephone networks, and may be built into the Intelligent Database by using available experience with sufficiently powerful general-purpose computers. The service database must provide for the capability of real-time operation when serving tens of millions of subscribers with a high rate of data access, shared access when handling simultaneous calls, capability of expansion of the number of subscribers served and types of services offered (i.e. "open" architecture), capability of organizing remote access. To meet these requirements, new principles of database design will be needed. Specifications should be developed for a new language of interaction between switching networks and informational databases. It is recommended that these questions be investigated by CCITT study groups. Figure 1, references 10: 7 Russian, 3 Western.

**From Armenia to America Via Intelsat***927K0278K Moscow ELEKTROSVYAZ in Russian  
No 1, Jan 92 p 45*

[Article by R. Levin]

[Abstract] In late October last year, a SESS automatic telephone system made by AT&T was put into service in conjunction with an Intelsat ground station in Armenia, providing telephone communication via satellite between Armenia and the United States. This project, completed by the joint efforts of specialists at the Armenian Ministry of Communications and AT&T, provides for introducing 180 direct international telephone channels to which 500 subscribers will be connected in the first phase of service. There is a one-time initial cost of \$3800.00 to the subscriber, and a call costs \$3.00/minute. As demand increases, the network will be expanded to include customers both in Armenia and in other republics. The transmitter of the Intelsat ground station has a power of 125 W, and the antenna is a 15.2 m parabolic dish. The total cost of the project was 5.7 million dollars, of which 1.95 million was contributed by Armenia. Additional outlays by the Armenian side for the transmission system, cable, construction of the building for the ground station and other expenditures did not exceed two million rubles. The station should pay for itself in two years, and profits will be shared equally by the partners. The SESS system will be serviced by Armenian specialists, and AT&T will make repairs if required. Figures 2.

#### **New Joint Venture M-Bell Established**

927K0278L Moscow ELEKTROSVYAZ in Russian  
No 1, Jan 92 p 46

[Article by I. Kovaleva]

[Abstract] An agreement was signed in November between Moscow Municipal Telephone Network and Bell Canada International to set up the joint venture M-Bell with State fund of 120 million U.S. dollars. BCI is engaged in active development of the telecommunications infrastructure of Saudi Arabia, Morocco, Venezuela, Malaysia and other nations in cooperation with their local companies. The operations of BCI are under the jurisdiction of Bell Canada Enterprise, a joint-stock holding company, which is also the governing body of BCE Mobile, Northern Telecom, Bell-Northern Research, and others. These wide-ranging interests have been the basis for contacts between BCI and Moscow Municipal Telephone Network, which serves 4 million customers, employs 17,000 people, has fixed capital of 1.5 billion rubles, unites general-user, mobile radiotelephone and special telecommunications networks, and provides consulting and other services to companies and scientific organizations both in the CIS and in other nations. The long-term program of the new joint enterprise M-Bell includes a wide range of projects in creating, developing and operating radiotelephone communication networks, information exchange between users, especially business partners, and upgrading the existing general-user telephone system by introducing digital technology. The joint venture will serve not only Moscow, but also the rest of the Russian Federation and other republics as well.

#### **Problems of Developing Superfast Information Processing Systems Based on Monolithic Integrated Circuits**

927K0278M Moscow ELEKTROSVYAZ in Russian  
No 1, Jan 92 p 47

[Article by Ye. Nefedov]

[Abstract] The Fourth All-Union Scientific-Technical Conference on Mathematical Modeling and Computer-Aided Design of SHF and EHF Electronic and Computing Systems Based on Monolithic Integrated Circuits (MIC) was held in September 1991 in Volgograd. The conference was attended by about 150 people from more than 30 cities. Because of insurance problems due to the volatile situation in Russia, a large contingent of eminent foreign scientists was unable to attend the conference. The work of the conference was done in eight sections: 1. SHF MICs: physics, principles, results, outlook; 2. SHF MICs: mathematical and electrical modeling, computer-aided design; 3. millimeter-wave MICs; 4. SHF and EHF MICs: active and nonlinear devices; 5. SHF MICs: antennas, transmission lines; 6. SHF MICs: component base, functional units, ASW and MSW devices; 7. Systems issues of constructing systems for computer-aided design of electronic equipment; 8. SHF MICs: technology, measurements, production. The fifth conference is to be held in 1993 in Rostov Velikiy.

#### **Development of Telecommunications**

927K0259A Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 92 pp 25-28

[Article by G. P. Zakharov, section head, Krasnaya Zarya Scientific Production Association]

[Abstract] The steps which are being taken to lessen the heavy costs of telecommunication equipment and services are reviewed. In many ways the CIS is lagging far behind the rest of the world in the digitization of networks and integration of different forms of telecommunications. The three principal stages in integration of telecommunication systems are examined with particular attention being given to structure and functioning of the N. ISDN and B. ISDN systems, hybrid, channel and packet commutation. The text is accompanied by block diagrams which are used as a basis for the discussion. The requirements for fast and slow dialogue are considered as part of the general user requirements (only the packet commutation method meets the needs of fast dialogue users). There is a thorough examination of the merits and shortcomings of channel commutation and packet commutation methods. The economic indices of CC and PC were investigated by the author in research revealing a general tendency to improvement in the economic advantage of networks with PC (two tables give the results of this research, revealing that PC is more economical than CC by a factor of 6). This research only further confirms the general conclusion that packet commutation networks are superior to those based on the channel commutation principle, according to data from

foreign authors, by a factor as great as 10. Many foreign companies are developing equipment for broadband digital integrated services which will apply packet commutation. Figures 4.

### **Power and Communication Lines on Common Supports**

*927K0259B Moscow VESTNIK SVYAZI in Russian No 1, Jan 92 pp 29-31*

[Article by V. F. Kalyuzhnyy, general director, Nauka MGNPP, Svyazstroy Association]

[Abstract] Throughout the country power and telephone lines follow the same paths from city to city and village to village, but in the CIS existing rules for the construction of communication lines and power lines provide for their complete separation and protection of communication lines against the electromagnetic influence of power lines. Moreover, these lines are serviced by personnel belonging to different departments (for the most part, Ministry of Communications and Ministry of Power and Electrification). The placement of these lines on the same poles or towers is still in its infancy. Meanwhile, enormous progress has been made in this field in Germany, United States, Japan and Australia. The situation in those countries is reviewed in order to illustrate the greater economy and efficiency resulting from such a change. The use of common supports for different kinds of lines has had to overcome strong bureaucratic resistance, particularly from the Ministry of Power and Electrification, which has wished to maintain its prerogatives (it has been argued, indefensibly, that their poles and towers cannot safely carry additional lines). However, with changing times and economic conditions the first steps have been taken toward joint suspension of lines and experimental lines are to be constructed in Russia, Ukraine and Kazakhstan. Foreign companies are seeking to become involved in this enterprise and their offers may be accepted, but this will entail great expense. This backward, inefficient situation is one of those which must be solved in order to set the country on a firm economic footing.

### **'TV Inform' System**

*927K0259C Moscow VESTNIK SVYAZI in Russian No 1, Jan 92 pp 38-41*

[Article by M. I. Krivosheyev, Radio Scientific Research Institute section head, Yu. M. Bolovintsev, laboratory head, and Yu. V. Zverev, chief engineer-designer]

[Abstract] Specialists at the Radio Scientific Research Institute have developed a circulatory communication system, the "TV inform," making it possible to disseminate to users different kinds of information embodied in a TV signal. The information incorporated into the TV signal can be transmitted to the zone of reception of Soviet TV programs. The TV signal is multiplexed with additional signals directly in the course of transmission

of programs, which is made possible due to use of modern technical equipment, some of which is briefly described. The system is intended for the dissemination of textual and facsimile messages, graphic (including half-tone) and test images to specific addresses. The "TV inform" system has many advantages in comparison with other systems for the multiplexing of TV signals: increased reliability in information reception; lesser dependence of quality of reception of digital information on conditions for TV signal reception; capability for working with different terminal equipment for reducing the distributed information to documentary form. The coding parameters are listed in a table and a block diagram of the circulatory system is given which is referenced to the text, providing information on its structure and functioning. The system is being used in disseminating press communications and textual and graphic information from the USSR Hydrometeorological Center; the users are subscribers both in the USSR and in foreign countries reached by Soviet TV. Figures 4.

### **Equipment for Increasing Efficiency of Digital Communication Lines**

*927K0259D Moscow VESTNIK SVYAZI in Russian No 1, Jan 92 pp 45-47*

[Article by V. P. Kokoshkin, candidate of technical sciences, deputy head, Radio Scientific Research Institute; N. I. Zachesov, laboratory head, and M. G. Volfson, deputy section head]

[Abstract] Work has now been completed at the Radio Scientific Research Institute on the "Obyedineniye Ts" outfit which ensures an increase in the efficiency in use of satellite and surface digital transmission systems. Use is made of the principle of digital interpolation of speech. It is intended for combining two digital flows arriving from two IKM-30 systems at a rate of 2048 kbit/s each and summation of the digital flow at a rate 2048 kbit/s. The analytic method and signal processing procedures used are discussed; a block diagram accompanies the textual description. Provision is made for the transmission of discrete information through two channels at a rate 64 kbit/s with the transmission of telephone messages through the other channels. Tests and experimental operation in Gomel Oblast in Belorussia confirmed the efficiency of the outfit and the possibility of doubling the traffic capacity of digital systems when carrying telephone messages without changing other standard line equipment. Joint operation of the "Obyedineniye Ts" with the IKM-30 exerts no influence on key electric parameters of audio frequency channels. This equipment operates from an AC 220-V network or 24- or 60-V DC networks. The outfit is constructed in the form of a console measuring 700 x 300 x 2150 mm. A single console can house two independent outfits which ensure transmission of 120 audio frequency channels through two digital channels. Figure 1.

**Communication on Threshold of Formation of an  
'Information Society'**

927K0259E Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 92 pp 60-64

[Article by V. K. Shultseva, scientific specialist, World Economics and International Relations Institute, USSR Academy of Sciences]

[Abstract] This is a review of the advances made in Western countries in the commercial and industrial use of telecommunications for promoting speed, efficiency and economic gain in conducting the business of large corporations (such as General Electric, IBM and Hewlett Packard), including those with foreign production, administrative and marketing facilities. Intraplant or intraenterprise communication systems are examined as well and in the 1990's it is expected that local communication systems will experience vigorous growth in the

automobile, chemical, food and similar industries. Thus, two different levels of such systems are examined and these are discussed in detail. A brief review of the effectiveness of satellite, fiber optics and cable systems also is given. The great importance placed on the upgrading of communication facilities is emphasized by the fact that in large corporations the expenditures on automation of such lines are second only to those on the work force. It is noted that by the late 1980's the optimistic predictions of specialists had not been fully justified and the reasons for this are considered, but it is clear that in the future greater efficiency and cost effectiveness will be realized by the combining of information facilities and communications equipment and the simultaneous transmission and processing of voice, digital and visual information. [This article represents the final part of a multipart article in this journal begun in Nos 10-12, 1991.] Figure 1.

**New Ways of Braking Contactless DC Motors**

927K0303A Moscow ELEKTROTEKHNIKA in Russian  
No 1, Jan 92 (manuscript received 14 May 91) pp 14-16

[Article by B. E. Kots and M. S. Zubrilov; UDC 621.313.13/17.001.4.]

[Abstract] There are three ways of braking a DC motor: generator braking, dynamic braking, and feedback braking. Generator braking is rarely used. In dynamic braking the braking moment is proportional to the frequency of the rotor rotation. This is effective in the initial stage, but as frequency increases, the braking moment falls. The most effective technique is feedback braking; however, it is possible to demagnetize the rotor poles. This prohibits its use in certain types of contactless DC motors. But "soft" feedback braking is possible, where the angle traversed by the rotor is equal to the "interswitching interval." Here the example is given of a two-phase contactless DC motor and an electronic switch. The motor has an armature and a rotor. The rotor position sensor consists of photodiodes and a signal element, a disk with a 90° groove cut into it. The switch consists of eight transistors which form two bridges and which switch the armature coils, which have two phases. When a signal is received from the photodiode, the voltage induced in one phase forms poles in the armature which are opposite in polarity to the rotor poles, creating a large braking moment. A braking moment is formed in one phase of the interswitching interval, but a motive moment is formed in the other. The average braking moment formed is larger than the average motive moment. Braking may take more than one interval in this soft feedback scheme. Modifications of this scheme are discussed. Figures 4; references 3 (Russian).

**Toward a Method of Calculating the Ventilation Noise of Electric Motors**

927K0303B Moscow ELEKTROTEKHNIKA in Russian  
No 1, Jan 92 (manuscript received 29 May 91) pp 19-20

[Article by M. P. Kukharskiy, B. N. Krivosheyev, and Yu. M. Kovalev; UDC 621.313.333.62-213.2.62-752.001.24]

[Abstract] The present method used to calculate the ventilation noise of asynchronous motors considers various factors including the position of the edges of the blades of the ventilator in space and their length. It is possible to calculate the noise of built-in ventilators with blades in a complex configuration. However, the resonant components of ventilation noise (structural noise) are assumed to be noise that does not change the dependence of noise level on the linear speed of the blades. Consequently, underestimates are obtained for slow-speed machines. An experimental study of ventilation noise in a wide range of speeds was performed. This noise has two components, aerodynamic noise and structural noise. The experimental data showed that in two-pole machines aerodynamic noise is predominant, and

in four-pole engines up to 50 Hz there is good agreement between the experimental and theoretical results; at lower frequencies, divergence increases. At lower frequencies structural noise predominates. A graph is provided of the dependence of ventilation noise level on the linear speed of the edges of the blades. An equation is derived for the noise level. Figure 1; references 2 (Russian).

**Electron-Beam Equipment for the Sign-Variable Power Supply of Electric Separators**

927K0303C Moscow ELEKTROTEKHNIKA in Russian  
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[Article by V. I. Perevodchikov, V. N. Shapenko, V. M. Stuchnikov, L. P. Aleksandrova, and N. V. Matveyev, V. I. Lenin All-Union Electrotechnical Institute]

[Abstract] Electric separators are used to filter dust-laden gases at thermoelectric power stations, as well as in metallurgy and other processes. Typically, unipolar separators are used, but the charge of the dust layer on the precipitation electrode increases until the voltage in the layer reaches the breakdown voltage. Then the "reverse corona" effect begins, leading to the formation of ions of the opposite sign in the space between the electrodes. The dust near the precipitation electrodes is neutralized and this decreases the effectiveness of the separator. One way of combatting this effect is the use of a sign-variable low-frequency power supply. The polarity of the voltage changes when the voltage in the layer approaches the breakdown voltage. When the polarity changes, the layer at the electrode switches sign, as do the particles between the electrodes, and the force acting on the particles is, as before, directed toward the precipitation electrode. Elimination of the "reverse corona" effect improves the effectiveness by a factor of 1.5-2. As the dust becomes more friable, the electrodes become self-cleaning. The schematic and specifications of this improved separator are presented, as well as test results. Figures 6; tables 2; references 3: 2 Russian, 1 Western.

**Electron-Beam Equipment for Metallurgy and Surface Modification**

927K0303D Moscow ELEKTROTEKHNIKA in Russian  
No 1, Jan 92 pp 34-40

[Article by V. I. Perevodchikov, Yu. V. Grigoryev, S. I. Gusev, Yu. A. Kovalenko, and V. F. Martynov, V. I. Lenin All-Union Electrotechnical Institute; UDC 621.3.032.269.1:669]

[Abstract] This article describes the current state of development of electron-beam equipment for use in metallurgy and surface modification (hardening, increasing resistance to wear and corrosion, etc.). A schematic is provided for a vacuum metallurgy unit. Its operation is described, and a table provides specifications for the cathode-ray gun and power supply. A survey of currently used equipment and recommendations for

improvements are made. The parameters of improved equipment which has been developed are provided. Testing was performed to determine the effectiveness of using electron-beam technology to harden motor parts (push rods, valves). Results are presented in a table. The hardness of parts subjected to electron-beam processing exceeded the hardness of steel by a factor of 1.5-2. The depth of surface modification was 120  $\mu\text{m}$ . The wear on non-processed parts was a factor of 2-3 greater. Ion-treated piston rings were also found to be more durable. Power supplies for electron-beam devices are discussed. Figures 9; tables 6; references 10 (Russian).

### Increasing the Specific Energy of Electric Capacitors by Introducing Polyvinylidene Fluoride into the Dielectric Structure

927K0303E Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 92 pp 52-54

[Article by A. M. Andreyev, O. K. Donskaya, E. M. Kostenko, O. L. Mezenin, and B. I. Sazhin; UDC 621.315.616:621.319.4.001.5]

[Abstract] This article presents the results of an experimental study of the temperature and frequency dependences of permittivity  $\epsilon$ , the tangent of the angle of dielectric losses  $\tan \delta$ , and short-term electric durability of films manufactured using lacquer-film technology by applying a coat of polyvinylidene fluoride 2  $\mu\text{m}$  and 10  $\mu\text{m}$  thick on a metallized polyethylene terephthalate (Dacron) film. There were separate and combined tests of polyvinylidene fluoride and polyethylene terephthalate. Changes in polyvinylidene fluoride for  $\epsilon$  and  $\tan \delta$  are in accordance with dipole polarization theory. In the combined films there was a significant decrease in  $\tan \delta$  compared to polyvinylidene fluoride. As the polyvinylidene fluoride content increased, permittivity increased. The maximum specific energy should be expected from a combined dielectric with a layer of polyvinylidene fluoride 2  $\mu\text{m}$  thick. The inclusion of polyvinylidene fluoride allows one to create capacitor insulation with an increased stored specific energy level with an acceptable level of loss to heat release. Comparison of energy capacities makes it possible to conclude that capacitor structures with polyvinylidene fluoride can be used for charging capacitors. While polyvinylidene fluoride films are most promising, an increase in the dielectric losses leads to thermal breakdown, limiting the use of these films in pulse capacitors. Figures 4; table 1; references 4: 3 Russian, 1 Western.

### Power Supply for 10 and 22 kHz Electrotechnical Equipment

927K0303F Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 92 pp 55-58

[Article by A. V. Ivanov, M. M. Mulmenko, A. Kh. Uzyanbayev, and R. G. Yunusov; UDC [621.314.632:621.382.233.026].001.4]

[Abstract] The absence of mass-produced thyristor transformers for frequencies above 10 kHz has hindered the introduction and development of advanced technologies which use ultrasonic electric energy (induction heating, laser and plasma technologies, etc.). This article reports the development of a new 10/22 kHz power source with a power of 100/63 kW. The device is intended for use in induction heating equipment. The design is discussed and oscillographs and specifications are presented. The device uses three-phase 380 V 50 Hz power. Its nominal voltage is 300 V, the nominal output voltage is 10/22 kHz, regulated voltage 7-10/14-25. The nominal power output is 100/63 kW, and can be regulated to 15-100/10-63. The device uses forced water cooling. Figures 3; references 9 (Russian).

### Frequency Dependence of the Effective Dynamic Resistance of Magnetically Soft Materials

927K0303G Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 92 pp 58-60

[Article by V. V. Krokhin, All-Union Scientific Research Design Technological Institute of Electric Machine Building; UDC 621.318.13.621.317.757.001.5]

[Abstract] The dynamic state of the remagnetization of magnetically soft materials are calculated with a dynamic state equation which satisfactorily describes various remagnetization modes affected by magnetic viscosity and eddy currents. The most difficult and least studied aspect is determination of the initial value of the effective dynamic resistance. This article examines the frequency dependence of the initial value of dynamic resistance for the main types of magnetically soft materials. Analysis of the frequency dependence of loss in remagnetization reveals that the frequency dependence of effective dynamic resistance has three characteristic regions. The first short region has a relatively fast rise in losses as frequency increases. In the larger second region, the rate of increase of losses is about constant, and as a rule, significantly less than in the first region. The second region is an exponential function of frequency, and the exponent is unambiguously defined by remagnetization mechanisms and, consequently, by the type and thickness of the magnetic material. The third region has a sharp increase in losses as frequency increases. Figure 1; table 1; references 10: 8 Russian, 2 Western.

### Automated Equipment To Wind the Coils of Superconducting Magnets for an Accelerator-Storage Complex

927K0303H Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 92 (manuscript received 2 Apr 91) pp 60-62

[Article by V. I. Dolzhenkov, V. V. Yelistratov, Yu. V. Kuznetsov, V. B. Petrov, V. V. Popov, A. V. Savelyev, B. V. Sokolov, V. V. Sytnik, N. M. Tarakanov, and Ye. A. Ustinov; UDC 621.318.2/3.001.4]

[Abstract] Devices were created to wind the coils of model (1 m) and full-scale (6 m) superconducting magnets. To provide flexible regulation of operations, all mechanisms are equipped with their own servo drives based on DC electric motors. Schematics are provided for the full-scale and model coil winders. Both devices are described in detail. The tension stabilization system is given special attention. The maximum cable tension is 800 N for both units. The tension stability for both units is  $\pm 5$  percent. The maximum carriage speed of the full-scale coil winder is 0.5 m/s. In the model coil winder the maximum platform rotation is 3 rad/s. Dipole coils up to 6 m in length can be wound on the full-scale winder (3 m quadrupole coils). The coils created with these devices have performed satisfactorily during several years of experimental testing. Figures 4; tables 2; references 5 (Russian).

#### **Consideration of Turbulent Phenomena in the Calculation of Switching Electric Arcs in Gas Blast Breakers**

927K0303I Moscow *ELEKTROTEKHNIKA* in Russian No 1, Jan 92 (manuscript received 11 Dec 90) pp 63-67

[Article by L. V. Shcheglov; UDC 621.316.542.027.3: 621.3.014.31.533.951.7.001.24]

[Abstract] The equations which describe the extinguishing of an arc in a breaker are complex, and the methods of solving these problems provide only a partial solution of the problem. These methods can be inaccurate, and the physics of processes in the arc extinguisher are completely excluded in some models. Difficulties are also encountered when the arc is not strictly cylindrical. Combined mathematical models make it possible to simultaneously consider the parameters of a specific gas extinguisher and its interaction with an electric circuit. It has been found that the main factor determining whether an arc is extinguished in a gas blast breaker is the free turbulence which arises as the arc interacts with the gas flow around it. Turbulent heat transfer from the arc column is considered in virtually all mathematical models. After the drawbacks of other models are outlined, the author presents his model, which considers the effect of various transfer mechanisms in the combustion of a gas blast arc. The mathematical model of a stable electric arc is used where the time derivatives are set to zero and integration is done over the cross section of the arc column. The model contains terms which reflect the transfer of mass, momentum, and energy through the lateral surface of the arc column due to molecular and turbulent mechanisms. Distinctions are drawn between molecular and turbulent mechanisms and how they are treated in the model. Macroscopic and microscopic behavior is examined. Figures 6; references 13: 8 Russian, 5 Western.

#### **Introduction of Equipment and Progressive Technology for Thermal Processing in "Thermoresurs" Engineering Center**

927K0302A Moscow *ELEKTROTEKHNIKA* in Russian No 2, Feb 92 pp 2-5

[Article by; I. E. Yarembash, candidate technical sciences; UDC 621.365.91:537.5]

[Abstract] A broader utilization of new materials and development of an efficient technology has been one of the most urgent tasks in the USSR scientific and technical program for the last ten years. This goal can be achieved by introducing surface and bulk thermal material processing, which would increase the work efficiency, utilize the resources more effectively, reduce the energy and material consumption and replace the existing process by ecologically clean one. The practical realization of this task consists in application of latest advances in the electrothermics and the material strengthening. In view of the above the "Thermoresurs" engineering center takes measures to promote and implement technological processes for strengthening the products made of steel, cast iron or solid alloys by methods of thermal and chemical processing as well as by applying protective coating. The most promising method used for chemical and thermal processing is ionic nitriding. A list is provided in this paper of examples using this and other technologies for thermal strengthening of products in the "Thermoresurs". The experience of the "Thermoresurs" operation demonstrated that the center is developing the necessary prerequisites for an intense introduction of the electro-thermal equipment and the material strengthening technology. Tables 2, references: 6 Russian.

#### **Equipment for Ionic Chemo-Thermal Processing**

927K0302B Moscow *ELEKTROTEKHNIKA* in Russian No 2, Feb 92 pp 7-8

[Article by; V. N. Blinov, candidate of technical sciences, V. G. Bogomolov, candidate of physical and mathematical sciences; UDC 621.785.002.5]

[Abstract] Ionic chemo-thermal processing of materials, including ionic nitriding, ionic grouting and cyanidation is gaining in popularity with the industry because of economic considerations, high productivity, ecologically cleaner processes, simplicity of controlling the structure of reinforced layer, prospect of full automation and also because of a better characteristic of the layer compared to the traditional methods. A table is provided in this paper which lists technical data of various equipment for the ionic nitriding, describing their purpose, operating conditions, dimensions, power, etc. It is pointed out that compared to the traditional gas grouting, the process of ionic grouting using the ionic chemo-thermal equipment makes it possible to reduce the processing cycle by a factor of 1.5-2.5, to improve the quality of the processed parts, and to reduce the relative consumption of carbonaceous gases by a factor of 20-30. Tables 1.